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SOME SOCIAL AND BIOLOGICAL CORRELATES OF CORONARY HEART DISEASE

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Abstract—The physiological links between social variables and the occurrence and course of coronary heart disease seem understandable, although they are not yet clearly delineated. Diet and activity patterns of Western industrial societies, as well as their increased latitude for social mobility and the striving behavior this fosters, might lead by various mechanisms to a biochemical environment in the blood stream which accelerates atherosclerosis, facilitates occlusion of coronary arteries, impairs blood supply to heart muscle, and makes arrhythmias and death more likely.

TO THE human biologist, social organizations are biological organizations. Men, who are the fundamental units of these organizations, spend a major portion of their time interacting with each other, and meeting the requirements of the organizations of which they are a part. These interactions require adaptations that affect human physiology as well as human behavior. They can, and often do, have a major influence on disease. Most human disease, except certain disturbances of mood, thought or behavior, does not appear to be primarily an adaptation to the social environment, but rather an adaptation to some combination of parasitic, traumatic, nutritional, biochemical, hereditary or degenerative influences which might otherwise destroy or permanently damage the human organism. Nevertheless, adaptations to the social environment may affect the course, the severity and the likelihood of occurrence of diseases of all sorts. As a result of this, many forms of behavior and many highly successful social adaptations, which are approved of and fostered by the social group, and which may be beneficial to the social organization as a whole, are not necessarily beneficial to the health of the individuals who are members of the organization.

Coronary heart disease may be used as an example of how adaptations to the social environment may influence a disease that seems to be fundamentally metabolic in its origin. This disorder appears to stem from metabolic characteristics that men share with other members of the higher phyla of the animal kingdom. Although men have been social animals for hundreds of thousands of years, their biochemical adaptive mechanisms were not designed to cope with social organizations so complex and so successful in producing food as those that have evolved over the last ten millenia. Like the majority of animals, men eat irregularly, and store their reserves of energy as fat. Any excess of food that men take in—fat, protein, or carbohydrate, animal or vegetable—they may convert to fat with some ease, and store. Along with the other vertebrates, men do have an arrangement for the storage of carbohydrate in the liver; but the amount of carbohydrate that they can store in their livers is quite small as compared with the amount of fat that they can store in their

tissues; and they do not have the capacity to manufacture carbohydrates from fat with ease, and in large amounts. When there is a demand upon their stores of energy, as there is during exercise, fever, or starvation, they meet this largely by mobilizing fat [1].

When fat is used as a metabolic fuel, it must be transported from one part of the body to another by way of the blood; but blood is a watery solution in which fat is not readily soluble. The fats that are present in the blood are in a variety of forms, each of which seems designed to circumvent in some manner the problem of insolubility. They appear as fat droplets in colloidal suspension ('chylomicra'), as fats bound to proteins ('lipoproteins'), and as free, or 'non-esterified', fatty acids ('FFA' or 'NEFA'). Closely associated with the fats is the substance cholesterol, which seems to play an important role in fat transport. More than half of the cholesterol in the blood is bound to the fats, chiefly in the lipoprotein fraction. Human blood, therefore, is a watery mixture which contains fat, both in suspension and in solution, somewhat as milk does.

When the concentration of fat in the blood changes, the concentration of cholesterol is likely to change in the same direction. However, as the adaptive demands on a man fluctuate, the various fractions of fat in his blood do not behave in precisely the same manner. The whole fats—the fat droplets—rise in concentration after a fatty meal, and almost disappear from the blood between meals: but they may rise again under circumstances of starvation. The Non-Esterified Fatty Acids, which are not primarily derived from food, but are drawn from the fat depots by the action of the nervous system, rise quickly during starvation or in situations of arousal or excitement, and fall promptly when carbohydrate food is eaten. The lipoproteins and cholesterol are not so labile. They maintain a rather steady high level when food intake is high, especially when the diet is high in animal fat, and they fall when the food intake is low [1, 2].

In general terms, it appears that the amount of fat and cholesterol in a man's blood depends upon the rate at which fat is supplied to his blood from the food that he eats, the rate at which it is taken up from the fat stores in his body, and the rate at which it is withdrawn from his blood by his muscles and other tissues. During periods when a man is consuming an ample diet relatively high in animal fat, the cholesterol and fat in his blood tend to be high. If his muscular activity increases, or his dietary intake decreases, the levels of fat and cholesterol in his blood tend to go down. If he should starve himself totally for a day or more the level of neutral fats, NEFA's, and ketone bodies (fragments of partly metabolized fat) in his blood rise temporarily as his body draws on its fat stores in order to conserve its stores of carbohydrate and protect the blood sugar level: but if his starvation continues, the level falls again. These biochemical adaptive reactions are mediated by his neuro–endocrine system. They involve shifts in the balance of activity between the hormones which promote fat utilization and cause withdrawal of fat from the storage depots, and those which promote carbohydrate utilization and cause fat to be stored [1, 3].

A metabolic reaction similar to that which accompanies starvation can be produced by muscular activity, which also causes a drain on energy supplies. In this situation, as in starvation, fat is mobilized from fat depots, and the muscles utilize relatively more fat and less carbohydrate [1]. The development of this metabolic reaction pattern does not have to wait until the muscular activity begins. Apparently it can be set in motion by the higher centers of the brain through their influence on the lower centers, which, in turn, control the activities of the endocrine glands. When information received by the brain leads it to react with a state of alertness, 'arousal', or 'preparation for activity'—implying, in effect, that there will soon be muscular activity with a consequent drain on the energy

stores—this metabolic reaction pattern may appear and there may be a mobilization of fat from depots, an increase in fat transport, and an increase in the utilization of fat, even before any muscular activity takes place [3, 4]. There is some evidence that such 'states of arousal' are associated with high levels of cholesterol in the blood, as well as of fat [5–9]. If muscular activity does not take place, but if a man nevertheless remains 'chronically aroused', it is conceivable that he might have a relatively high level of fat transport and fat utilization over a long period of time.

All of these metabolic phenomena seem to be relevant to the development of atherosclerosis, not because atherosclerosis itself has any adaptive value, but because a sustained high level of fat and cholesterol in the blood, occurring for whatever reason, seems to cause these substances to accumulate within the walls of arteries, and eventually to block the blood supply of tissues essential to life, and especially that of the muscles of the heart. As American men grow older over a period of years these deposits of fat and cholesterol appear in their arteries to an ever greater extent. Traces of such deposits can be found in the arteries of men in their teens and early twenties [10], but usually these do not become large enough to cause serious trouble until the forties and fifties. The rapidity with which these deposits develop and their magnitude are closely related to the amount of fat and cholesterol that usually circulates in the blood [2, 11], although the exact means by which they are produced is still a matter of debate.

As atherosclerotic deposits develop in the coronary arteries they sooner or later impair the blood supply to an area of heart muscle. If they cut off the blood supply completely, they may lead to a 'myocardial infarction'. If they cut it off only partly, so that the blood supply to an area of the heart muscle is present but inadequate, the electrical activity of this muscle can be disturbed, and the heart may become susceptible to disturbances of its rhythm. Also, under these circumstances, the blood supply to the heart muscle may be adequate when the heart is beating slowly and the demands of the circulation are not great; but if the heart rate and the blood pressure rise because of exercise or excitement, the blood supply may be inadequate, and a pain in the chest (angina pectoris) may develop. Myocardial infarction, arrhythmias, and angina pectoris are the important causes of death and disability in coronary heart disease. However, because of the richness of the blood supply to the heart muscle and its capacity to develop a collateral circulation when part of the circulation is cut off, even quite extensive deposits of atherosclerotic material may appear in the walls of coronary arteries without producing any symptoms or any impairment of cardiac function. In some instances complete occlusions of coronary arteries may occur and an area of heart muscle may die without producing any symptoms that are recognized as those of a myocardial infarction. Thus, a very large proportion of coronary atherosclerosis and perhaps a fifth of all coronary occlusions and myocardial infarctions are 'silent' and unrecognized at the time that they occur.

It is through these and similar physiologic phenomena that the behavior of men, their relations to the men around them, the requirements of their social groups, and the characteristics of their societies, influence the occurrence of coronary heart disease. For example, the disease is uncommon in primitive societies and in societies characterized by a low standard of living and a relatively inadequate food supply [2, 11]. Several factors seem to account for this. In the first place, the life expectancy in these societies is low. Only a small proportion of the people in them survive until the sixth or seventh decade, when coronary heart disease most often becomes manifest. In the second place, inadequate nourishment, relative or absolute, is a characteristic of a great many people in such societies. Probably

as a result of this, their level of circulating fat and cholesterol is a good deal lower than the level exhibited by people in societies that have a higher standard of living and a more abundant food supply [2, 11].

On the other hand, coronary heart disease is quite prevalent in the industrial societies of Europe and North America. These societies have long-lived populations, with a high life expectancy, and a large proportion of people in the older decades of life. Their abundant food supply has produced a high level of relative obesity throughout their populations. This is associated with a high level of fat and cholesterol in the blood of many men in these populations [2, 11].

The nature of the appetite-regulating mechanism of men seems to be in part responsible for the prevalence of obesity in modern societies. This mechanism was evolved at a time when the chief threat to the survival of our human precursors was an inadequate food supply, and long periods of starvation or semistarvation were features of the life cycle of almost every individual. In general, the mechanism provides an insistent hunger drive, which recurs within a few hours after a meal is eaten, and generally drives a man to seek food again. Accompanying this is a much weaker satiation mechanism, which allows a man who is faced with abundant food to eat far more than he immediately needs. One can see how such an arrangement had a very high survival value in food-gathering or hunting and fishing societies, and how it worked rather well in agricultural societies so long as these were at the rather primitive level of technology which characterized agriculture throughout the world until a few generations ago; but the development of techniques of food production and distribution of high efficiency, which has characterized the European and American societies of the last 75 years or more, has presented whole populations with an abundant food supply not interrupted by any periods of inadequacy except those created by the two great wars. Living in such a setting of abundant food, men have to make almost a conscious effort to avoid becoming obese. As a result of this, not isolated men, but whole populations have become relatively overweight, and have relatively high levels of fat and cholesterol in their blood. This is thought to be a primary reason for the high level of coronary heart disease in such societies.

Yet the role of food in coronary heart disease is not simply a matter of its availability. Food preferences and food habits play an important and sometimes subtle part in the development of this disease. Until very recently, obesity has been a sign of affluence and good health in many societies, and obese women have been regarded as especially attractive by many social groups. However, at the present time, upper and upper-middle class groups in the United States and in some other countries regard obesity as undesirable and physically unattractive. Many members of these groups deliberately restrict their food intake and engage in physical exercise. This may account for the fact that obesity seems to have a negative social class gradient in American society. Among urban Americans, there seems to be more obesity among people of lower-middle class than among those of upper-middle and upper class [12]. There is evidence from several studies of industrial groups, and from urban population surveys, that suggests that coronary heart disease is distributed in a similar manner [13–17]. By contrast, in India, and in some other societies in which the lower social groups live at a marginal subsistence level, the social class gradient for coronary heart disease is in the other direction—the middle and upper classes have a higher incidence than the lower classes [18].

Food, of course, has a prestige value and a taste value, as well as a metabolic value. Animal fat and protein in the form of meats and dairy products have always been high

prestige foods, as well as highly tasteful foods—the food for feasts, the food for guests, and the food of the well-to-do. During the past 50 years, these foods have also been widely advocated as having special nutritive value. It has been thought that one of the special benefits of American society is the wide availability of such foods for great numbers of people. The increasing availability of these foods in Europe since World War II has been taken as one of the primary evidences of the increasing affluence of European society. The Russians have made special efforts to make more food of this type available for their own population. While it has not been unequivocally established that food of this sort bears a primary responsibility for the high levels of coronary atherosclerosis in these societies, there is a great deal of evidence that it does play a role of importance [2, 11]. One may speculate that changes in dietary intake may have been responsible for the change in the gradient of coronary heart disease in the British population during the two decades from 1930 to 1950. In 1930, the social class gradient of coronary heart disease in Britain was like that of India at the present day—the disease was more common among men in the upper classes and less common in the lower classes. This trend has flattened out in subsequent decades [19, 20]. The change might be attributable to the fact that over these decades the standard of living of the average working man in Great Britain has improved steadily, and animal fat and protein may have formed a much larger proportion of his diet than they used to do in the decades before the first World War.

It is also possible that the social class gradient itself is largely a reflection of the different diagnostic terms used by physicians who treated upper and lower class patients. A change in gradient, if it is truly present might also be a reflection of the change in the level of physical activity in the British population [21]. It seems clear that heavy physical work or constant muscular activity can keep down the level of circulating fats and prevent the occurrence of atherosclerosis, even in people who eat a highly atherogenic diet. The Masai tribesmen of East Africa who consume nothing but meat and dairy products, but walk some forty miles a day while herding their cattle, have low levels of serum cholesterol and little or no atherosclerosis [22]. Levels of physical activity as high as this have largely disappeared from Western society. They persist only in isolated segments of the society, among farm laborers and railroad track workers, for example. Our own society now regards such heavy physical labor as undesirable, and is replacing it as rapidly as possible with the labor of machines. Yet, wherever such physically active groups have been studied, they have shown lower levels of coronary heart disease than other similar members of the population. Thus, one hears that farm laborers have less coronary heart disease than urban workers [23], and, likewise, that there is less coronary heart disease in track workers than in railroad clerks [24], less in postmen than in postal clerks, and less in bus conductors than in bus drivers [25].

The role of chronic states of arousal in coronary heart disease remains an enigma. It has been proposed by many that the time demands of Western society, the "pace of life", the mobility of people—occupational, geographical, and social—and the many contingent demands of life in such societies create a high level of arousal among the members of their populations, which contributes to the high incidence of coronary heart disease among them [26–32]. Presumably, it does so in two ways: first, because, other things being equal, relatively aroused people might have a higher level of circulating fats and cholesterol, which would contribute to coronary atherosclerosis [4, 6]; and secondly, because aroused people might have a higher level of circulating catecholamines [33]. In lay terms, they might be subject to more nervous stimulation of their hearts, and this, in turn, might

make them more subject to fatal arrhythmias, especially if they have hearts that are already damaged by atherosclerosis. Some have hypothesized that this susceptibility of aroused people resides primarily in certain members of the population who have personality traits characterized by striving, goal-directed, restless behavior, accompanied by impatience [26, 27, 29]. Others have hypothesized that this susceptibility resides particularly in those members of the population who are exposed to social, geographic, or occupational mobility [28, 30–32]. The data bearing on these points have been equivocal, because it has been hard to devise suitable means of measurement and apply them to populations in a way that would yield meaningful answers.

Retrospective studies have long suggested that there are certain personality traits which turn up frequently in people who already have coronary heart disease [26, 29]. Recently, ROSENMAN and FRIEDMAN and some others have presented evidence that people who exhibit such traits may indeed have an increased risk of coronary heart disease [34]. Current data suggest that this risk operates primarily in men below the age of fifty. The populations thus far studied have been made up primarily of middle and upper class urban individuals. At the present moment the extent of the additional risk that may be associated with personality factors cannot be stated with precision.

SYME [32], STAMLER [35], and TYROLER and CASSEL [36], among others, have produced evidence that intergenerational mobility and intercultural mobility may be associated with differences in the risk of coronary heart disease. These differences are not necessarily due to the direct metabolic effects of attempting to make an adaptation from one society to another. They may well be due to differences in the entire pattern of life between two societies or two generations. The same may be said about the effects of moving from a rural to an urban environment. In assessing the effects of mobility there is also the problem that whenever certain members of the population voluntarily choose to move from one society, one job, or one location to another, these people may possess personality traits which systematically differentiate them from others in the same population who choose not to move. Although some surveys of occupational groups have suggested that there is a marked difference in coronary rates among people of different occupations [37, 38], careful studies of large industrial groups have not yet confirmed this [13, 16, 17]. Such studies, in general, have shown only that industrial employees exhibit a social class gradient that may be common to urban Americans. The executives and upper-level managers seem to have lower rates for coronary heart disease than the workmen and lower-level managers.

As we have pursued our own studies of social mobility, personality, and coronary heart disease [39], we have been more and more impressed by two phenomena which I believe are recognized by most of those who are now working in this area: (1) that social and behavioral variables cannot be dealt with in broad, general categories, such as "stress" or 'mobility', but must be studied as discrete, carefully limited, and rigorously defined concepts or entities; and (2) that the occurrence of clinical coronary heart disease is the outcome of a complex interaction of many variables in which no single variable predominates to the extent that we find, for example, in the infectious diseases.

Within the general concept of social mobility, one can recognize such phenomena as 'status mobility', 'occupational mobility', and 'organizational mobility' as discrete phenomena, which have a different meaning for the individual and may have very different physiological consequences for him. Furthermore, as aspects of 'organizational mobility', one can recognize both 'upward' and 'lateral' mobility as somewhat different phenomena, which also have somewhat different implications. Still further, the phenomenon of 'upward

organizational mobility' has a systematically different meaning for different men who may be involved in it. In one of our industrial groups, LEHMAN has found evidence that the attitudes, the behavior, and the emotional reactions of upwardly mobile high school graduates promoted from the ranks are systematically different from those of college graduates in the same jobs in the same organization who have experienced the same degree of mobility [40]. Undoubtedly his examples could be repeated many times. Much of the difficulty with the study of social phenomena in relation to coronary heart disease appears to have arisen from efforts to relate the disease to broad, general, and ill defined social variables.

The complex interaction of many social and biological variables becomes all too evident when one studies human populations intensively. In one of our industrial populations, it appears that the high school graduates may possibly be systematically different from the college graduates, not only in their father's occupation and income, but also in the size of their families of origin, in the age at which their fathers died, in their eating habits, in the amount of obesity among them, in the age at which they began to smoke cigarettes, and in the number of cigarettes they have smoked during their lifetime*. In both groups, the men selected for promotion seem to be slimmer and better educated than the men not promoted, and their personality traits, as measured by psychological tests, are different in a number of respects. Furthermore, those who are 'upwardly mobile' are initially more healthy than those who are not mobile, if only because the chronically-ill and those who die early do not have the opportunity to be mobile.

In summary, the link between the social and biological variables that are related to coronary heart disease seems to be based on quite understandable physiological processes, even though the precise nature of these processes have not been worked out in detail. The social variables relevant to coronary heart disease are not readily investigated as broad, general phenomena, but, in any given instance, must be dealt with as discrete, though complex, processes often highly specific to a given situation and to the characteristics of the people involved in it. The development of clinical coronary heart disease in a given individual appears to be the outcome of a complex interaction between a number of important variables. At the present time, it cannot be primarily ascribed to the effects of any single variable. While the potential role of social variables in this disease seems clear enough, their relative importance cannot be evaluated until they have been studied more carefully and more extensively. In the long run, the practical value of studies of social variables and coronary heart disease might be very great; for if changes in the prevalence of coronary heart disease must be dependent upon changes in patterns of diet, patterns of smoking, patterns of behavior or patterns of interaction between people, these are more likely to be brought about through changes in social values and attitudes than through the traditional methods that the public health officer and medical practitioner have used in the past.

* Cigarette smoking is another variable that has a strong positive association with coronary heart disease. Evidently, this is partly a result of a direct effect that some substances present in tobacco smoke have on the blood vessels, for smoking has an adverse influence on some other forms of vascular disease as well as on coronary vascular disease. Furthermore, people who stop smoking have a risk of subsequent coronary heart disease that is less than one would have expected had they continued to smoke. However, this is not the whole story. Among urban Americans, cigarette smoking has a negative social class gradient—it appears that people of lower class background begin to smoke earlier and smoke more than those of middle or upper class background. It also seems likely that more 'aroused' people who 'drive themselves harder' may smoke more than those who do not. So, it appears possible that some of the association between cigarette smoking and coronary heart disease may be attributed to the characteristics of the people who smoke cigarettes. [41—43].

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Résumé—Les maladies coronaires présentent un risque principalement aux membres de sociétés modernes qui n'éprouvent pas le manque de nourriture et l'effort physique qui étaient inévitables quand le système régulateur du métabolisme humain se développa. Les hommes mangent irrégulièrement, et emmagasinent des graisses pour leur énergie. Les graisses sont transportées avec du cholestérol à des emplacements de stockage et à des matières organiques par l'entremise du flot sanguin sous des formes diverses qui varient en quantité selon nourriture journalière absorbée et l'activité physique. En général quand un homme absorbe une nourriture contenant une proportion élevée de graisses animales, de protéine, et de calories, et est relativement sédentaire, il maintient un niveau élevé de graisses et de cholestérol dans son sang.

Dans les cas d'inanition, ou lorsqu'une activité musculaire élevée crée un appel d'énergie, une réaction d'adaptation métabolique a lieu par l'entremise du système neuro-endocrinien. L'équilibre se déplace d'hormones favorisant l'utilisation d'hydrates de carbone et l'emmagasinage de graisses, à des hormones favorisant la mobilisation et l'emploi des graisses. Le niveau des graisses dans le sang s'élève d'abord, mais baisse ensuite à mesure que les matières organiques utilisent des graisses pour l'énergie.

"L'éveil" des centres supérieurs du cerveau peut mettre en train ce mode de réaction comme une "préparation à l'activité". Si une activité musculaire ne suit pas et un homme se trouve "éveillé chroniquement", on pense que les graisses et le cholestérol dans son sang peuvent rester en quantités élevées pendant de longues périodes.

L'artériosclérose (c. à d. Le dépôt de graisses et de cholestérol dans les parois artérielles) commence chez les hommes entre treize et dix-neuf ans, progressant avec l'âge. Le taux de développement et la taille des dépôts dépendent des quantités de graisses en circulation. Des dépôts dans les artères coronaires diminuent la quantité de sang fournie au muscle du coeur, causant des douleurs dans la poitrine, peut-être un trouble fatal au rythme du coeur, ou la mort du muscle cardiaque. Les maladies coronaires symptomatiques commencent à apparaître vers les quarante ans, et existent dans le cas d'un nombre étendu d'américains aux environs de 60 et 70 ans. Les maladies coronaires sont rares dans les sociétés primitives dont les membres ont une espérance de vie réduite, une nourriture insuffisante, et des quantités de graisses et de cholestérol réduites en circulation. Elles sont générales parmi les populations industrielles occidentales, bien nourries et à longues vies. Une obésité relative est répandue dans ces sociétés, ou des aliments très prisés, à contenu élevé de cholestérol tels que la viande et les produits laitiers sont abondants et où l'activité musculaire fatigante a été réduite de façon prononcée par les machines. A une époque un signe de richesse, l'obésité est maintenant plus répandue dans les groupes sociaux urbains inférieurs en Amérique, et les maladies coronaires suivent apparemment cette influence sociale. Les maladies coronaires sont moins répandues dans les groupes de salariés occupés à de gros travaux.

Il a été difficile d'étudier les effets postulés "d'éveil chronique" causés par les besoins à temps compté de la société occidentale et les occasions qui se présentent à elle de mobilité sociale, d'emploi ou géographique. Des compotements présentant des efforts ou des sentiments d'inquiétude chez des hommes avec des maladies coronaires évidentes ont été observés et paraissent associés à un danger accru. Un état plus répandu a été démontré pour des hommes pouvant se déplacer sans entraves culturelles ou géographiques; mais quand à savoir si ceci représente une dynamique d'adaptation, les différences statiques dans un nouvel environnement, ou simplement les caractéristiques des personnalités des individus qui ont choisi de se déplacer n'est pas connu. La mobilité sociale a des sens différents pour des hommes avec des espoirs différents, et peut dépendre de la santé, du bon état physique, et de caractéristiques se rapportant à la personnalité—facteurs qui influencent aussi les maladies coronaires.

Il est clair que ces variables sociales complexes sont liées physiologiquement aux maladies coronaires. Mais les rapports qui existent entre elles doivent être examinés par des études conçues avec soin de variables bien définies si le lien doit être compris.

Sumario—La enfermedad de las arterias coronarias es una dolencia que afecta primariamente a los miembros de las sociedades modernas, cuyos miembros no experimentan la falta de alimentos y el esfuerzo físico que eran inevitables cuando se desarrolló el sistema regulatorio del metabolismo humano.

Los hombres comen irregularmente y almacenan grasas para su conversión en energía. La circulación de la sangre transporta las grasas y el colesterol a los depósitos de almacenaje y a los tejidos en formas distintas cuya cantidad fluctúa de acuerdo con el consumo diario de alimentos y la actividad física. En general, cuando un hombre consume una dieta con una proporción alta de grasa animal, proteína y calorías, y lleva una vida relativamente sedentaria, el nivel de grasas y de colesterol en su sangre es elevado.

Durante períodos de hambre, o cuando una gran actividad muscular crea una demanda de energía, ocurre una reacción metabólica adaptable mediada por el sistema neuro-endocrino. El centro del equilibrio se traslada de las hormonas que promueven la utilización de carbohidratos y la acumulación de las grasas a las hormonas que promueven la movilización y el uso de las grasas. El nivel de grasas en la sangre se eleva al principio, pero decae despues cuando los tejidos utilizan las grasas para producir energía.

El "despertamiento" de los centros superiores del cerebro puede iniciar este tipo de reacción como una "preparación para la actividad". Si a ello no sigue una actividad muscular y si el hombre permanece "crónicamente despierto", se cree que el colesterol y las grasas en la sangre se mantienen elevados durante largos períodos de tiempo.

La ateroesclerosis (v.g. la acumulación de grasas y de colesterol en las paredes de las arterias) comienza en los hombres entre los 13 y 20 años y va progresando con la edad. La cantidad y régimen de acumulación están relacionados con la cantidad de grasas en circulación. Tales acumulaciones en las arterias coronarias dificultan el suministro de sangre al músculo del corazón y causan dolor en el pecho, trastornos posiblemente fatales del ritmo cardíaco, o la muerte del músculo del corazón. Los síntomas de enfermedad de las arterias coronarias comienzan a revelarse hacia los 40 años y la enfermedad se encuentra presente en una gran proporción de los norteamericanos de 60 y 70 años.

La enfermedad es rara en las sociedades primitivas cuyos miembros tiene una expectación de vida corta, una dieta inadecuada y una cantidad baja de grasas y de colesterolen circulación. Prevalece en las poblaciones industriales occidentales bien alimentadas y de larga vida. La obesidad relativa está muy extendida en estas sociedades, en las que abundan los alimentos de gran prestigio y alto contenido de colesterol, tales como carne y productos lácteos, y en las que las máquinas han reducido notablemente el trabajo muscular pesado. En algún tiempo una señal de afluencia, la obesidad prevalece actualmente más entre los grupos urbanos de clase media en América, y la enfermedad de las arterias coronarias parece seguir esta graduación de clases. La enfermedad es menos común en los grupos ocupados en trabajos pesados.

Ha resultado difícil estudiar los efectos postulados del "despertamiento crónico" causado por las demandas de tiempo en la sociedad occidental y sus oportunidades de movilidad social, profesional y geográfica. Se han observado formas de comportamiento inquieto y esforzado en hombres que sufren manifiestamente de enfermedad de las arterias coronarias, y parecen estar asociadas con un mayor riesgo de la enfermedad. Se ha demostrado que esta última es más prevaleciente entre los hombres de alta movilidad intercultural y geográfica, pero se desconoce si ello refleja la dinámica de adaptación, las diferencias estáticas en el nuevo ambiente, o simplemente las características de la personalidad de la gente que decide mudarse. La movilidad social tiene significados distintos para hombres con esperanzas diferentes y

puede depender del estado de salud, aptitud y rasgos de la personalidad, factores estos que también influyen en la enfermedad.

Estas variables sociales complejas están claramente ligadas fisiológicamente a la enfermedad de las arterias coronarias, pero sus correlaciones han de ser exploradas mediante estudios cuidadosamente proyectados de variables discretas y bien definidas para llegar a comprender la naturaleza de esa ligazón.

Zusammenfassung—Koronarherzleiden ist ein Gefahrmoment hauptsächlichst für Bewohner der modernen Welt, welche der zur Zeit der Entfaltung des menschlichen Stoffwechselsteuerungssystems unvermeidlichen Nahrungsknappheit und körperlichen Erschöpfung nun nicht mehr ausgesetzt sind.

Der Mensch isst unregelmässig und speichert Fett zum Energieverbrauch an. Das Fett wird gemeinsam mit Cholesterin zu Speicherablagerungen und zu Geweben durch den Blutstrom in verschiedenen Formen, deren Menge je nach der täglichen Nahrungszufuhr und der körperlichen Tätigkeit schwankt, abgeführt. Im allgemeinen bewahrt der Mensch, der eine, an tierischen Fetten, Eiweisstoffen und Kalorien reichhaltige Kost verzehrt und einer relativ sitzenden Beschäftigung nachgeht, einen hohen Grad von Fett und Cholesterin im Blut.

Während Hungerperioden oder wenn schwere Muskeltätigkeit einen extra Energieaufwand erfordert, vollzieht sich eine adaptive, metabolische Reaktion, die durch das neuro-endokrine System vermittelt wird. Das Gleichgewicht bewegt sich von hormonaler Förderung der Kohlenhydratauswertung und Fettanlagerung zu hormonaler Förderung des Fettumlaufes und Fetteinsatzes. Anfangs steigt der Blutfettspiegel, um später, wenn die Gewebe das Fett für Energieaufwand verwenden, abzufallen.

"Erweckung" der höheren Gehirnzentren kann dieses Reaktionssymptom als eine "Tätigkeitsvorbereitung" einleiten. Man nimmt an, dass das menschliche Blutfett und Cholesterin bei ausbleibender Muskeltätigkeit und andauernder "Erweckung" lange Zeit erhöht bleiben kann.

Atheromatöse Sklerose (d.h. Fett- und Cholesterin-ablagerungen in den Arterienwänden) beginnt beim Menschen zwischen dem 13. und 19. Lebensjahr und schreitet mit zunehmendem Alter fort. Der Entwicklungsgrad und das Ausmass der Ablagerungen hängen mit der Menge des zirkulierenden Fetts zusammen. Ablagerungen in Kranzarterien beeinträchtigen die Blutzufuhr zum Herzmuskel und verursachen Brustschmerzen, möglicherweise verhängnisvolle Störungen im Herzrhythmus oder Tod durch Versagen des Herzmuskels. Das Erscheinen von symptomatischen Koronarherzleiden beginnt in den vierziger Jahren und ist im hohen Ausmass bei Amerikanern im sechzigsten oder siebzigsten Lebensjahr vorhanden.

In primitiven Gemeinschaften, deren Mitglieder eine kurze Lebensspanne und durch mangelhafte Kost eine niedrige Fett- und Cholesterinzirkulation zu erwarten haben, sind Koronarherzleiden selten. Diese grassieren unter der langlebigen, gutgenährten industriellen Bevölkerung des Westens. Fettleibigkeit ist in diesen Gemeinschaften relativ weitverbreitet, da hohes Prestige, cholesterin-reichhältige Nahrung wie Fleisch und Molkereiprodukte im Überfluss vorhanden sind und schwere körperliche Tätigkeit durch Maschinen-einsatz bedeutend verringert wurde. Fettleibigkeit—einst ein Zeichen des Überflusses—ist jetzt häufiger bei den städtischen, unteren Bevölkerungsschichten in Amerika verbreitet und hat scheinbar auch bei dieser Klasse Koronarherzleiden zum Gefolge. Die letzteren treten weniger häufig bei Schwerarbeitern auf.

Es war schwierig, die postulierten Wirkungen von "chronischer Erweckung", welche in den westlichen Gemeinschaften durch Zeitbeanspruchung und die Gelegenheit zur gesellschaftlichen oder geographischen, beruflichen Mobilität hervorgerufen werden, zu studieren. Vorwärtsdrängende, restlose Verhaltenssymptome wurden bei Menschen mit offensichtlichen Koronarherzleiden beobachtet und scheinen mit erhöhten Gefahrenmomenten verbunden zu sein. Weiteres Überhandnehmen zeigt sich bei interkulturellen und örtlich mobilen Menschen; allerdings ist unbekannt, ob dies die Anpassungstriebkraft, die statischen Unterschiede in neuer Umgebung oder einfach die individuellen, charakteristischen Eigenschaften von Leuten, die Fortbewegung gewählt haben, widerspiegelt. Gesellschaftliche Beweglichkeit wird von Menschen mit ungleichen Erwartungen verschiedenartig ausgedeutet und kann vom Gesundheitszustand, der körperlichen Eignung und von persönlichen Zügen abhängen—alles Umstände, die Koronarherzleiden gleichfalls beeinflussen.

Offensichtlich sind diese komplexen, sozialen Variablen physiologisch mit Koronarherzleiden verkettet. Ihre gegenseitige Beziehung muss jedoch durch sorgfältig geplante Studien der einzelnen, genau definierten Variablen erforscht werden, wenn die Art des Verbindungsgliedes erkannt werden soll.